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Variable Viscosity of Water as the Controlling Factor in Energetic Quantities That Control Living Systems: Physicochemical and Astronomical Interactions

Lukasz M. Karbowski[a], **Michael A. Persinger**[b]

Laurentian University, Sudbury, Ontario, P3E 2C6, Canada

[a,b]E-mail address: kx_karbowski@laurentian.ca , mpersinger@laurentian.ca

ABSTRACT

The emergence of energy from the product of viscosity, volume and intrinsic or extrinsic frequency indicates that the ten fold difference in this property displayed by water could define the boundary of the physicochemical conditions of living systems. Intra-aqueous energy induced by geomagnetic variations and experimental time-varying magnetic fields within specific volumes of water maintained in static, dark conditions can be manifested as photon emissions with shifts in spectral power that approximate the width of the plasma cell membrane. Various manipulations of the viscosity of water accurately predicted the frequency required to affect intracellular organelles such as vesicles as well as the intramolecular pressures that affect interactions with photons. Application of the Smoluschowski-Einstein relation to the proton, the mediator of pH and the dynamics of the hydronium ion, potentially explained the vector characteristics of the frequency band of extremely low frequency magnetic fields that slow malignant cells. The derivation of viscosity from the inverse of the Newtonian Gravitational Constant, diffusivity and the square of the applied frequency indicates that resonant oscillations between the solid earth and the atmosphere and unit variations in solar flux density may be relevant variables.

Keywords**:** viscosity; water; interfacial water; intrinsic energy; fluorescence spectrometry; magnetic fields; intramolecular pressure; Smoluschowski-Einstein effect; Gravitation

1. INTRODUCTION

The importance of the intrinsic variations in values of viscosity (η) within aqueous systems for determining their intrinsic energies and subsequently the wavelengths spontaneously emitted as photons has not been explored systematically. If viscosity is the term employed to represent the resistance of a fluid to gradual deformation then there should be an energy contained within the system that is associated with this physical reluctance. One would anticipate that the intrinsic and transient organization within water that has been described as coherent domains within which applied magnetic fields can be contained [1] or geometric arrangements of oscillating arrays [2] require intrinsic energies. These energies

would emerge not only from the thermal phenomena coupled to absolute temperature but also from the basic properties of protons and electrons that composed the molecular networks.

One of the assumptions of the general quantum concept is that the bases of information as digital or 0,1 sequences is mediated through packets of discrete energy that are shared by local and non-local mechanisms [3]. Thus changes in the properties of media within which physicochemical reactions should result in specific quantities of energy. Typically non-intercalated processes could interact to produce qualitatively different phenomena. The central manifestation of these phenomena should be dependent upon photon emissions that reflect both measures of intensity (radiant flux density) and spectral power density. There is now strong evidence that photons are the primary mediators of inter-molecular, inter-cellular [4], inter-organismic [5] interactions through which complex information is conveyed.

We have assumed that photon-related viscosity phenomena should be related to the most fundamental physical and chemical properties of matter. For example the diffusivity value ($0.88 \cdot 10^{-7}$ $m^2 \cdot s^{-1}$) derived from the ratio of the unit magnetic moment of a proton ($1.41 \cdot 10^{-26}$ $A \cdot m^2$) and the unit charge ($1.6 \cdot 10^{-19}$ $A \cdot s$) multiplied by the viscosity ($8.94 \cdot 10^{-4}$ $kg \cdot m^{-1} \cdot s^{-1}$) of water around 25°C results in a force of $7.87 \cdot 10^{-11}$ $kg \cdot m \cdot s^{-2}$ [6]. When this force is applied over the distance of two O-H bounds ($1.92 \cdot 10^{-10}$ m) the energy is $1.5 \cdot 10^{-20}$ J. This is with range of the intrinsic energy associated with neuronal action potentials, agonist-receptor interaction, the potential between potassium ions that contribute to the resting membrane potential [7] and even the electron affinities between nucleobases for DNA [8].

According to Decoursey [9], the second shell hydrogen bonds are in the order of $1.8 \cdot 10^{-20}$ J per molecule and is consistent with the measurements of the mobility of protons (H^+) within water. These mobile protons function as a dynamic "thread" that maintain a matrix for interactions of chemical species within a fixed volume of water by producing and moving through transient ($\sim 10^{-12}$ s) hydronium ions (H_3O^+). They determine pH which then affects chemical reactions. Very narrow ranges of pH between 6.2 and 7.2 can affect angiogenesis and metastasis [10].

There is theoretical and empirical evidence that proton flux [11] through proton channels within the plasma membrane may be the prototypic source for electrical potentials because of the emergent property of interfacial water that occurs along a surface. As demonstrated by the imaginative experiments of Pollack and his colleagues [12-14], the increased viscosity within the exclusion zone that emerges as an interface between the surface and bulk water and the formation of a concentrated layer of protons produces voltages that are the same order of magnitude as the resting plasma membrane potential of living cells.

Quantifying the role of viscosity at the most basic level of proton magnetic moment and the unit charge to mediate energy that may serve as the quanta of communication between chemical reactions at their large aggregates (such as the cell) may be revealing. In water the viscosity can range from $1.00 \cdot 10^{-3}$ Pa·s at 20 °C to $6.3 \cdot 10^{-4}$ Pa·s for physiological (37 °C) temperature. The viscosity of vital fluids such as blood is about 4 times greater than water. The corresponding viscosity for hematocrit values between 60 and 20 range from 7.2 to $2.6 \cdot 10^{-3}$ Pa·s, respectively, according to Rand and Lacome [15]. Intracellular viscosity has been inferred to be about 1.4 greater [16] in one type of cell (fibroblasts) than extracellular water and as high as $6.8 \cdot 10^{-2}$ Pa·s. The viscosity of Pollack's Exclusion Zone where aggregated shells of protons produce as much as 100 mV potential differences can be a factor of 10 higher than bulk water. Here we develop the potential relevance of the narrow-band variations in viscosity from chemical, physical, and astronomical perspectives.

2. INTRINSIC ENERGY DERIVED FROM VISCOSITY OF WATER

The product of viscosity (η), the volume (V) under consideration and intrinsic frequency (Hz) is energy (J). In basic units this is:

$$J = (kg \cdot m^{-1}s^{-1}) \cdot m^3 \cdot s^{-1} \qquad (1).$$

It indicates that water of a specific volume that is oscillated by forces, internal or external, mechanically or electromagnetically has the potential to contain a specific quantity of energy. In one of our experimental settings where quantities of 10 cc of spring water were placed in cell culture dishes and allowed to sit in the dark for several days to ensure thixotrophic effects [17], the determination of estimated intrinsic energy contained within this volume, assuming ~10^{-3} Pa·s viscosity, would only required frequency. Assuming a low frequency associated with increased geomagnetic intensity, such as an equivalent 5 min periodicity (3.3 mHz), the quantity would be $3.3 \cdot 10^{-11}$ J.

The potential relevance of this prediction was measured by a phenomenon observed initially by the second author while monitoring background photon flux density by analogue photomultiplier tubes (PMTs). He noted that when quantities of 10 cc (10^{-5} m^3) of spring water were placed over the aperture that the mean photon flux densities increased sufficiently to be discernable over the background of $5 \cdot 10^{-12}$ $W \cdot m^{-2}$ during some but not all increases in geomagnetic field intensity. The effect was transient and was maintained in the order of one or more kiloseconds after the onset of the geomagnetic activity as measured by a MEDA magnetometer whose sensor was 2 m away from the PMT sensor.

The inconsistency was later discerned to relate to the rise time for the maximum increase in local geomagnetic intensity. According to the intrinsic energy (J) for that space containing that quantity of water would be:

$$J = (B^2) \cdot (2\mu \cdot s)^{-1} m^3 \quad (2),$$

where B is the strength of the field change, μ is the magnetic susceptibility ($4\pi \cdot 10^{-7}$ $N \cdot A^{-2}$) s is the rise time and m^3 is the volume of water. For the occasional increase in magnetic field strength above 100 nT within 300 s the power ($J \cdot s^{-1}$) would be $1.3 \cdot 10^{-16}$ W. Given that the aperture of the PMT was ~10^{-4} m^2, this would be equivalent to about $1.3 \cdot 10^{-12}$ $W \cdot m^{-2}$. This value was at the margin of detection by the system. However it suggested that the stored magnetic field energy could be re-released as photons within a range that overlaps with the visible and near-ultraviolet and near-infrared. The equivalent power within that volume of water due to the viscosity of the water (equation 1) requires the square of the frequency. If the same frequency (3.3 mHz) were applied, then the power would be $1.1 \cdot 10^{-13}$ W or about 10^3 more than the induced power from the increased geomagnetic intensity. For the maintained geomagnetic intensity to converge with this potential contained within the viscosity approximately 20 min (1 ks) would be required. This transience of the phenomenon would be congruent with the experimental observations [18,19].

3. FLOURESENCE SPECTROMETRY EVIDENCE

We have shown spring water that remains unmoved and in hyper-darkness for several days while being exposed to physiologically-patterned, weak (μT range) magnetic fields

created by specific point durations (3 ms) exhibits increase photon emission as measured by fluorescent spectrophotometer. The static condition of the spring water during the exposure to the magnetic field is essential because agitated movements (e.g., transport) before the measurement eliminate the effect. These observations are consistent with the production of thixotrophic phenomena or the increased viscosity that is associated with quantities of water that are not moved and remain in darkness. This effect has been reported by other researchers [17].

The 3 ms point durations refer to the time each point or value between 0 and 256 that is converted to between -5 V and 5 V (127 = 0 V) is generated by the computer software through the digital-to-analogue converters that result in the current applied through the application geometry. In these studies the field was applied through a large coil in order to increase the homogeneity of a given intensity across the volume of the water sample. The samples of water were placed approximately 1 m away from the vertical face of the coils. Point durations for the same patterned field that were 1 ms or 4 or 5 ms did not produce the enhancing photon emission.

The selection of the 3 ms point duration was derived from both theoretical concepts from basic astronomy as well as empirical verification. Persinger and Koren [20] had suggested that the expansion coefficient reflected in Hubble's parameter ($2.4 \cdot 10^{-18}$ s^{-1}) could be related to the space occupied by a particle. For a proton the value would be $8 \cdot 10^{-33}$ $m \cdot s^{-1}$. Consequently the time to expand one Planck's length ($1.6 \cdot 10^{-35}$ m) from the context of this model would be that value divided by the expansion velocity. The median solution, given the range in Hubble's constant, was about 3 ms. On the other hand the solution for the electron was about 1 ms.

Subsequent experiments involving the "excess correlations" of photon emissions from chemical reactions separated by non-traditional distances supported the specific parameters [21]. This was tested by measuring the simultaneous output of two identical photochemical [3] or pH reactions [22] separated by 10 m but that shared the same changing magnetic fields with changing angular velocities generated around a circular array of solenoids. Proton-related phenomena were optimal with 3 ms point durations while electron-related phenomena were optimally evoked by point durations of 1 ms [23]. The selection of integer values was determined by the limits of the software that generated the magnetic fields.

As described by Murugan et al [24], the spectrophotometer registered the photon emissions for wavelengths between 350 nm and 470 nm. The major consequence of exposing spring water to the physiologically patterned magnetic fields was a shift of the peak in photon emissions by about 10 nm, the width of a plasma cell membrane, towards longer wavelengths. The shift emerged at about 400 nm and slowly attenuated between this value and 450 nm. The calculated energy associated with this shift was about 10^{-20} J which is well within the range associated with second shell values of the hydrogen ion [9]. The mobility of H^+ through the matrices of hydronium ions is associated with this energy.

If viscosity is the controlling value then its characteristics should be reflected in the dominant wavelength of the photons spontaneous emissions once energy (J), in this case the magnetic form, has been stored within the volume of water. Assuming $\eta = 0.79 \cdot 10^{-3}$ $kg \cdot m^{-1}s^{-1}$ for the viscosity of spring water at 25 °C and $1.8 \cdot 10^{-20}$ J for the second shell energies of hydrogen, and $3.33 \cdot 10^{2}$ Hz was the effective frequency of 3 ms point durations, then the volume (m^3) can be discerned by:

$$m^3 = J(Hz \cdot \eta)^{-1} \quad (3),$$

or, $0.68 \cdot 10^{-18}$ m^3. The cube root of this value is 408 nm which is well within the range of the wavelength where the shift occurred for the increased power flux density of photons from the water exposed to the weak temporally asymmetric magnetic fields in a static, hyper dark environment.

The total energy (J) as photons associated with the exposure to the magnetic fields within that environment was predicted by the classic formula which is the same as equation 2 but with s^{-1} (frequency) removed. In this instance the total energy stored within the water matched the summed energy of the increased photon emission from that water as discerned by fluorescent spectrophotometer. However these calculations indicate that the wavelength of the energy emitted as photons was determined by the viscosity of the water within the volume within the cuvette.

4. ESTIMATING INTRINSIC FREQUENCIES

Similarly we could predict frequency of the system (resonant or intrinsic) by knowing the implicit energy and the viscosity by:

$$f = E\,(\eta\, m^3)^{-1} \quad (4).$$

Discrete volumes of similar chemical structures are formed ubiquitously within discrete subsets or micro-boundaries or "vesicles". The Golgi apparatus contributes in large part to the concentration of proteins within these vesicles whose widths range from 70 to 300 nm. At presynaptic locations within the brain the widths of the vesicles range between 15 and 75 nm [25].

If we assumed the persistent energy value of $2 \cdot 10^{-20}$ J, the viscosity of water measured by Margraves et al [26] within human brain tumor (T98G glioblastoma) cells ($6.8 \cdot 10^{-2}$ kg $\cdot m^{-1}$ s^{-1}) that display an average diameter of 496 nm then an intrinsic frequency can be estimated. Assuming the volume of the vesicles within these tumor cells would be $6.1 \cdot 10^{-23}$ m^3 the intrinsic frequency is ~5 Hz. This frequency solution is well within the range of the natural oscillation band that produces mobilization and release of vesicle pools at neuromuscular synapses [27].

The above equation predicts the time constant of asynchronous or spontaneous releases of the contents of synaptic vesicles should reflect the 5 Hz value in general even in other cell preparations with comparable vesicular dimensions. Goda and Stevens [28] measured time constants between 100 and 200 ms or 10 to 5 Hz for hippocampal synapses for cultured cells. Stevens and Williams [29] confirmed that only about 25 to 30 action potentials at 20 Hz are sufficient to elicit exocytosis from readily releasable pools of synaptic vesicles.

5. APPLICATION TO THE S-E RELATION

Brownian motion is classically defined by the Smoluchowski-Einstein (S-E) relation where the diffusion constant (D) in $m^2 \cdot s^{-1}$ is:

$$D = kT(6\pi\eta r)^{-1} \quad (5),$$

where k is the Boltzmann constant ($1.38 \cdot 10^{-23}$ $J \cdot T^{-1}$), T is temperature in Kevin, η is the viscosity of the medium and r is the particles radius.

If we assume a radius of $0.66 \cdot 10^{-15}$ m for a proton (1/2 the Compton λ) and the viscosity inside tumor cells is $6.8 \cdot 10^{-2}$ Pa·s then for the diffusion constant is $2.1 \cdot 10^{-6}$ $m^2 \cdot s^{-1}$. Multiplied by the mass of a proton ($1.67 \cdot 10^{-27}$ kg) all that is required is frequency to obtain energy. This produces an interesting "boundary condition" for the relationship between the first applied frequency and subsequently Planck-related energy.

If the applied frequency is 6 Hz, the resulting energy is $21 \cdot 10^{-33}$ J. When divided by the central quantum value, Planck's constant ($6.626 \cdot 10^{-34}$ J·s), the functional frequency is 32 Hz. Interestingly, this is consistent with the upper and lower boundary for the frequency-modulated electromagnetic field configuration, presented with 3 ms point durations, that has produced the most effective diminishment of cancer cell proliferation. Reversing the presentation of the pattern (32 Hz to 6 Hz) produced no diminishment of malignant cell growth. Growth of normal or non-malignant cells was not affected by this configuration [19].

6. INTRAMOLECULAR PRESSURE AND PHOTON PHENOMENA

Viscosity is effectively pressure distributed over time which means that it is force per unit area as a function of time. The force (F) between two water molecules each with a unit charge can be estimated by classic formula:

$$F = (q^2) \cdot (4\pi\varepsilon r^2)^{-1} \quad (6),$$

where q is the unit charge, ε is permittivity and r is the distance between the charges.

For the distance between water molecules ($2.97 \cdot 10^{-10}$ m) and the permittivity complex ($4\pi\varepsilon_o$) equal to $1.11 \cdot 10^{-10}$ $C^2 N^{-1} m^{-1}$, the force would be $2.6 \cdot 10^{-9}$ N. When applied over the area of the water molecule ($8.8 \cdot 10^{-20}$ m^2) an inordinately high pressure of $0.29 \cdot 10^{11}$ Pa results. This pressure multiplied by the volume of the water molecule ($26 \cdot 10^{-30}$ m^3) results in an intrinsic energy of $7.7 \cdot 10^{-19}$ J or the frequency (by dividing by Planck's constant) $1.16 \cdot 10^{15}$ Hz. This is equivalent to a wavelength, assuming the velocity of light in a vacuum ($3 \cdot 10^8$ $m \cdot s^{-1}$) of ~260 nm.

This wavelength is within the ultraviolet component of the photon spectrum. More importantly it is within normal fluctuation of the peak (~270 nm) for absorption within the exclusion zone for a variety of substances as reported by Pollack and his colleagues [30]. Viscosity can be increased by a factor of 10 within the exclusion zone. The magnitude of the absorption peak was directly related to the molarity and hence indirectly to contributing factors to the narrow-band changes in viscosity. At 5.3 M NaCl within pure water (55.35 M) where there were 10 water molecules surround each solute molecule the 270 nm peak was maximum. At 1 M, or approximately 50 to 60 water molecules per salt molecule, the peak submerged into background.

The solutions from the calculations and Pollack's remarkable early research indicate that the pressure generated by the charges between water molecules per area of the molecule but then generated through its occupied volume can produce a condition that allows similar wavelength absorption. By implication the energy could be emitted at different (usually longer) wavelengths when triggered by appropriate stimuli that alter the supporting molecular configuration. The most typical candidate is the proportion of H^+ or hydronium ions that determine pH.

7. GRAVITATIONAL VARIANTS

An alternative derivation for viscosity involves the Gravitational constant $6.67 \cdot 10^{-11}$ m^3 $kg^{-1}s^{-2}$. Viscosity can be derived by:

$$\eta = G^{-1} (m^2 \cdot s^{-1}) s^{-2} \quad (7).$$

In other words a natural viscosity emerges from the product of the inverse G, the target measure of diffusivity (δ) and the square of the frequency.

Hence if the viscosity is known, the intrinsic frequency from potentially any source that could affect the system can be estimated by:

$$f = \sqrt{(\eta(\delta \cdot G^{-1})^{-1})} \quad (7).$$

The empirical H^+ diffusion constant at 20°C on earth is $8.65 \cdot 10^{-9}$ $m^2 \cdot s^{-1}$ [9]. Assuming a general viscosity of functional fluid, for example the blood (~$2.5 \cdot 10^{-3}$ Pa·s), the frequency would be about 4.3 mHz. This periodicity is remarkably similar to one of the intrinsic resonant oscillations between the solid earth and atmosphere. Nishida et al [31] found that the average values of two of the fundamental spherical modes with amplitudes in the order of $0.5 \cdot 10^{-11}$ $m \cdot s^{-2}$ (0.5 nGal) showed marked annual variation with peak-to-peak values of about 0.1 to 0.2 (0.4 to 0.6) nGal. The two peak modes were 3.7 mHz and 4.3 mHz.

At the level of the average cell (10 μm width) with a mass of $5 \cdot 10^{-13}$ kg the force generated by a perturbation of $0.5 \cdot 10^{-11}$ $m \cdot s^{-2}$ is $2.5 \cdot 10^{-24}$ N. When applied across the 10^{-8} m of the plasma cell membrane the energy is $2.5 \cdot 10^{-32}$ J. The equivalent frequency, dividing by Planck's constant is about 38 Hz. The expected variation of the mass of a cell (assuming a standard deviation is about 30% of the mean) would indicate that most (68%) of the cells would display intrinsic variations of between 27 Hz and 50 Hz.

The power associated with the resonant oscillations of the earth when coherent with the cell would not be trivial. The energy of $2.5 \cdot 10^{-32}$ J oscillating at 4.3 mHz would result in a power of $1.1 \cdot 10^{-34}$ W. When divided by the area of the membrane ($3.14 \cdot 10^{-12}$ m) the flux density would be $3.5 \cdot 10^{-23}$ $W \cdot m^{-2}$. If the frequency were congruent within the 2.8 GHz, range this means that a shift of only 1 SFU (solar flux unit) would share the quantitative values to intercalate with the typical cell. This increment of magnitude has been related to a number of geophysical and biological phenomena [32].

In the above equation (7) the controlling variable would be viscosity because G and δ would be effectively constant. Thus a range of viscosities within the cytoplasm or clearly within the interfacial water boundaries of exclusion boundaries would have the capacity to shift the intrinsic frequency into or outside from the fundamental oscillations associated with entire earth and its potential modulation by subtle changes in solar radiation.

7. CONCLUSIONS

The variable values of viscosities of water containing ions, that can range by a factor of 10 between bulk and interfacial (adjacency to surfaces) forms, could contain the intrinsic energy that are functional boundaries for physiological changes important for cell survival. Temporally patterned and specific strengths of weak magnetic fields can interact with the viscosity-related energies to affect the spectral power density of photon emissions and

absorptions that can simulate the essential geometric and temporal parameters of the living system including intracellular organelles such as vesicles and the width of the plasma cell membrane. The derivation of viscosity from a relationship that involves the Gravitational constant and the fundamental mode frequencies of the solid earth-atmospheric oscillations indicate flux densities from astronomical energies can be more significant than presently appreciated.

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